

honour of the late Professor K. Kraepelin whose works on the scorpions of Western Australia are well known.

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## THE REPTILIAN FAUNA OF THE ISLANDS BETWEEN DONGARA AND LANCELIN, WESTERN AUSTRALIA

By JULIAN FORD, Attadale.

Along the coastline between Dongara and Laneelin are some 35 aeolianite limestone islands. They vary in size from 0.1 acre to 64 acres, lie from about 100 yards to six miles off the shore, are sometimes covered with dune sand, and were cut off from the mainland as a result of a post-Pleistocene rise in sea level (Churchill, 1959; Main, 1961). Their flora is typical of that occurring on small limestone islands along the west coast (*cf.* Storr, 1961). In 1959, 1960 and 1961, a detailed survey of the avian, mammalian and reptilian faunas was undertaken, this contribution giving details of the occurrence and ecology of the reptiles.

Since island size is significant in an ecological discussion, their areas in acres are given below:

Beagle Islands		Essex Rocks	
north-west island	1.2	north island	1.0
south-west island	0.6	middle island	0.7
east island	3.8	south islet	0.3
Lecman-Green Head group		Sandy Knoll	
Snag Island	0.5	north island	1.0
Drummond Rock	0.1	south island	0.5
Webb Islet	0.4	Ronsard Bay	
Llpfert Islet	0.5	north rock	0.1
Orton Rock	0.1	south rock	0.1
Milligan Islet	0.5	Cervantes Islands	
Fisherman Islands		north island	8.0
north island	3.5	middle island	0.5
south island	1.0	south island	2.3
Sandland Island		Green Islets group	
	3.6	north island	4.0
Jurien Bay group		south island	8.5
Favourite Island	7.5	Whittell Islet	0.6
Boullanger Island	64	Buller Island	1.1
Whitloek Island	13.4	Flat Rock	0.2
Tern Islet	0.5	Wedge Island	4.8
Osprey Islet	0.3	Laneelin Island	18.8
Escape Island	26	Edward Island	0.4



## Family: Geckonidae

**Gymnodaectylus milii** (Bory)

Common on the north and south Cervantes Is., but absent from the middle island. Found under slabs of limestone. On the mainland it is located under slabs of rock and logs, and in the stumps of dead blackboys.

**Phyllodaectylus marmoratus** (Gray)

Plentiful on Sandland I. and the north and south Green Islets; scarce on Milligan Islet and Buller I. Lives under limestone rocks. On the mainland it lives under the loose bark of trees, under logs and slabs of rock, and under sheets of galvanised iron on the ground.

**Phyllodaectylus ocellatus** (Gray)

Plentiful on the northern end of Boullanger I., on Whitlock I., Escape I., and the north and south Cervantes Is.; scarce on Tern Islet. Occurs under slabs of limestone, both on the islands and the adjacent mainland.

## Family: Scincidae

**Tiliqua branchialis** (Gunther)

Appears to be common on the central west side of Lancelin I. where there are numerous slabs of limestone under which it lives. It occurs in similar habitat on the adjacent mainland.

**Egernia kiugii** (Gray)

Plentiful on many of the larger islands including Boullanger, Escape, the north and south Cervantes Is., and the north and south Green Islets. Inhabits the burrows of the shearwaters *Puffinus pacificus* and *P. assimilis*. It occurs in the coastal dune zone of the adjacent mainland but appears to be relatively scarce.

**Egernia pulchra** Werner

Plentiful on all the large islands of the Jurien Bay group, viz., Favourite, Boullanger, Whitlock and probably Escape. Inhabits crevices between and under rocks, and less frequently, petrel burrows. This particular form of *pulchra* is very distinctive and will be described in a separate paper. Apparently absent from the adjacent mainland.

**Egernia bos** Storr

Abundant on Sandland, Favourite, Boullanger, Escape and Lancelin; common on the middle Essex Rock. Possibly occurs on Whitlock I. although several attempts to locate it have been negative. This species makes shallow burrows, sometimes up to three feet in length, usually having several escape holes. It has not been seen on the adjacent mainland.

**Lygosoma (Sphenomorphus) iesuenerii** Dumeril and Bibron

Common on Sandland, Favourite, Boullanger, Laneelin and south Green Islet; scarce on Wedge I. Possibly occurs on Eescape and Whitlock. Usually active on the surface and lives under leaf litter and small depressions under rocks. Plentiful on the adjacent mainland but the population density would be lower than that of the islands.

**Lygosoma (Sphenomorphus) labillardieri** (Gray)

Laneelin I. only. Occurs in depressions in the sand under slabs of limestone where it appears to be not uncommon. Specimens are readily separable from those taken on the mainland and a full description will be given in a separate paper. The species has not been observed on the adjacent mainland but it is plentiful in the Darling Range country where it is found under rocks and logs.

**Lygosoma (Hemiergis) quadrilineatum** (Gray)

Relatively plentiful on the north and south Cervantes Is., the north Green Islet, and the north Essex Rock, less common on the middle Essex Rock. Found under rocks in sandy situations on the islands and the mainland. It is difficult to assess its relative abundance on the adjacent mainland but appears to be scarce.

**Lygosoma (Rhodona) lineopunctulatum** (Dumeril and Bibron)

Occurs on Boullanger and Whitlock Is. where it burrows in sand under limestone rocks. Because of its cryptic habits, no assessment of its status both on the islands and on the mainland can be made.

**Ablepharus lineo-ocellatus** (Gray)

Plentiful on the north Cervantes I., the north Green Islet and Laneelin I.; scarce on the north Fisherman I., the middle Cervantes I. and Buller I.; rare on the east Beagle I. Lives under leaf litter and rocks. Also common on the mainland but the population density would be less than that on the islands where this reptile is abundant.

**Ablepharus elegans** (Gray)

One specimen was collected in a petrel burrow on the north Fisherman I.

The families Pygopodidae, Agamidae and Varanidae, and snakes are not represented although some of the Jurien Bay islands appear to be large enough for snake lizards, worm lizards and snakes.

No lizards were found on the following islands despite diligent searching and they are therefore assumed to be absent: the two western Beagle Is., some of the small islands between Leeman and Green Head (Snag, Drummond, Webb and Lipfert), south Fisherman I., Osprey Islet, south Essex Rock, Whittell Islet and Edward I. The Sandy Knoll islands and Flat Rock were not visited.

ZOOGEOGRAPHICAL ASPECTS

Except for *Egernia bos* and *E. pulehra*, which have a southern distribution, the reptiles found on the islands between Dongara and



Lancelin are known to occur on the adjacent mainland (Glauert, 1961). A *bos*-like form occurs on Bernier I. (Storr, 1960), and possibly more extensive collecting will reveal all *Egernia* species on the adjacent mainland. It is therefore felt that no zoogeographical nor past-climatic inferences can be made at present.

## ECOLOGICAL FACTORS

### (a) PHYSICAL FACTORS

The number of species on an island is a function of the habitat diversity which depends on the size of the island. This is demonstrated by the fact that the largest islands have the largest number of species; for example, Boullanger I. has six species; Lancelin, six; north Cervantes I., five; Escape, four; and north Green Islet, four; while on some of the smaller islands only one or two species, such as a gecko or one of the small skinks, persist. Generally large islands have a greater number of available habitats. Habitat impoverishment and size reduction are continuous processes under the weathering action of the sea, wind and rain, until the stage is reached where the island is no longer suitable for any species; this appears to be the case with Drummond Rock, Lipfert Islet, Orton Rock, south Essex Rock, Osprey Islet, Ronsard Bay rocks and possibly Whittell Islet.

### (b) BIOTIC FACTORS

#### (i) Effects of Other Animals

Islands inhabited by a large population of Hair Seals (*Neophoca cinerea*) invariably have a paucity of lizards both in species and numbers since the carrying capacity of the island is apparently reduced by the disturbing effects created by seals as they drag themselves over the ground, thus forming numerous broad tracks amongst the vegetation and causing a hard crust to form on the surface of the sand. On the Beagle Islands, where the seal population is probably in the vicinity of 100 individuals, only one reptile, a single individual of *Ablepharus lineo-ocellatus*, has been observed, and this was on the largest island of the group. The north Fisherman I., populated by about 60 seals, has two reptile species, *Ablepharus lineo-ocellatus* and *A. elegans*, but the latter would be relatively undisturbed by seal activity since it lives in petrel burrows and not on the surface. Other islands regularly inhabited by seals and having but few reptiles are the north Essex Rock (one species—*Hemiergis quadrilineatum*) and Buller I. (two species—*Ablepharus lineo-ocellatus* and *Phyllodactylus marmoratus*) although only about half of the latter island is affected by seal activity. Islands of sufficient area to hold reptiles but which are apparently devoid as a direct result of seal activity are the two western Beagle Is. and the south Fisherman I. The northern end of the south Cervantes I. is frequented by seals and does not have any lizards; however, the main plateau of this island is inaccessible to seals and has a high reptile population. Only one island, Sandland I., inhabited by a breeding population of seals, has a large population of reptiles and a relatively high number of species—*Egernia bos*, *Sphenomorphus*

*lesueurii* and *Phyllodactylus marmoratus*, but only about half of the island is disturbed and the seal population probably does not exceed 10 individuals.

A few islands, such as Edward, Snag and Webb Is., appear to be devoid of reptiles because of the activity of sea-birds, mainly the Pied Cormorant (*Phalacrocorax varius*), continually depositing a layer of guano over the islands. This phenomenon, however, becomes important only on small islands. The effects of the burrowing sea-birds, which include the Wedge-tailed Shearwater (*Puffinus pacificus*), Little Shearwater (*Puffinus assimilis*) and the White-faced Storm-Petrel (*Pelagodroma marina*), are difficult to assess but they probably contribute an extra habitat in their burrows since these are frequented by a number of reptile species.

Probably the only important avian predator on the island reptilian fauna is the Kestrel (*Falco cenchroides*). This species breeds on Sandland, Favourite, Boullanger, Escape (?), Green Islets, Wedge and Lancelin Is., and is invariably observed hovering over the islands. It is significant that no Kestrels have been observed on the Beagle and Fisherman Is., which have small reptile populations, although the bird's absence may be due to the fact that the islands lie 6 and 3.5 miles respectively from the coast and thus do not have close proximity to the mainland where the bird species is common. The Sacred Kingfisher (*Halcyon sancta*) has been observed on Whitlock, Escape, Essex Rocks, Cervantes, Green Islets, Wedge and Lancelin and would no doubt be an efficient predator. The Boobook Owl (*Ninox novae-zeelandiae*) and the Barn Owl (*Tyto alba*) have been observed on Favourite and Boullanger Is. respectively, but since they appear to be only casual visitors and are nocturnal in habits, their predatory effect would be of little importance except possibly on the geckos which are active at night.

That only one reptile species, *Sphenomorphus lesueurii*, has been collected on Wedge I., despite its relatively large size, may be due to the island being joined during the summer period by a wide sandbar to the mainland allowing small mammal predators to gain access. A small burrowing animal and the Fox (*Vulpes vulpes*) inhabit both the island and the adjacent mainland. Wedge I. may thus be considered to be a part of the mainland. Boullanger and probably Whitlock Is. are inhabited by the Dunnart (*Sminthopsis murina*) which is carnivorous but whether it takes reptiles is not known. The introduced mouse (*Mus musculus*) also occurs on Boullanger I.

#### (ii) Competition in Reptiles

A striking feature of many of the island reptilian populations, compared with that on the adjacent mainland, is that there are fewer species represented but they exist in greater density of individuals. This suggests that the total population of a fauna is not proportional to the number of species composing it, but to the carrying capacity, and that the population of the respective species in a fauna is dependent on the number of competing species. Thus

the reduction of interspecies competition on the islands has allowed the few species present to reach greater densities than they do on the adjacent mainland, as already indicated for local islands by Serventy (1951).

In a study of the role of interspecies competition amongst passerine birds, Crowell (1962) has shown that the reduced competition on the island of Bermuda has allowed the fewer species present to attain greater densities than in continental North America. The increase in Bermuda appears to have been accomplished through broader tolerance of small or localised differences in habitat permitted by the absence of species normally competing for such sites. The replacement of missing species occurred without the acquisition of new behaviour since adaptive zones or niches are actually overlapping rather than discrete. Habitat tolerance of the reptiles on the Western Australian coastal islands is somewhat broader than on the mainland, particularly on those islands having a low number of species.

Interspecies competition probably accounts for the irregular distribution of several species (Serventy, 1951; Main, 1961). This is best exemplified in the genus *Egernia*. Only on two, possibly three islands, viz., Favourite, Boullanger and Escape (?), do both *E. bos* and *E. pulchra* occur, but since their preferred habitats are sufficiently large on these islands, *E. bos* living in shallow burrows in sandy situations and *E. pulchra* in crevices between limestone rocks, there is no undue ecological overlap. On Sandland I. and the middle island of the Essex Rocks, *E. bos* is the only representative and frequently lives in small burrows under rocks. *E. bos* on Lancelin does not burrow under rocks, this niche being occupied by *Sphenomorphus labillardierii* and *Tiliqua branchialis*. Whitlock I. is apparently only inhabited by *E. pulchra* which in addition to living in rock crevices, occupies petrel burrows. The distribution data indicate that when Sandland, Whitlock, middle Essex and Lancelin Is. were cut off from the mainland, they were probably inhabited by both *E. pulchra* and *E. bos*. Thus it appears that with the gradual reduction of island size, the distinction between ecological niches ceases to prevent undue competition so that one or the other species is eliminated.

In the case of *E. kingii* and the two smaller *Egernia* species the only overlap occurs on the largest islands, viz., Boullanger and Escape, and where *E. kingii* is the only representative of the genus, such as on the north and south Cervantes Is. and the two Green Islets, it is considerably more abundant. Of course the competition between these species only becomes important when the island has been reduced to a certain minimum size, and results in the extinction of one, then two species, whence only one survives as is now the case on eight islands. It has already been pointed out that on islands only inhabited by *E. bos*, this species takes over the *pulchra* habitat. This also applies to *E. kingii* which, on the Cervantes Is., lives



under slabs of limestone in addition to petrel burrows but on Whitlock I., where only *E. pulchra* occurs, the reverse situation is found.

An interesting feature concerning the reptilian distribution on the two Green Islets is that *Sphenomorphus lesueurii* and *Ablepharus lineo-ocellatus* seem to replace one another, the former occurring on the south island and the latter, on the north, although the islands are only some thirty yards apart. These two species appear to have similar adaptive zones and only occur together on Lancelin I.

The geckos *Phyllodactylus marmoratus* and *Phyllodactylus ocellatus* have not been found on the same island. Their ecological adaptations appear to overlap broadly.

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